

Contents

Chapter 13 Light and Glare.....	13-1
13.1 Introduction.....	13-1
13.1.1 Overview of the Chapter.....	13-1
13.2 Affected Environment.....	13-2
13.2.1 Affected Environment Common to All Systems	13-2
13.2.1.1 Regulatory Environment.....	13-2
13.2.1.2 Light and Glare Sources and Measurement.....	13-3
13.2.2 Affected Environment: Route 9 Treatment Plant	13-5
13.2.2.1 Observation Point 7.....	13-7
13.2.2.2 Observation Point 8.....	13-7
13.2.2.3 Observation Point 9.....	13-7
13.2.2.4 Observation Point 10.....	13-7
13.2.2.5 Observation Point 11.....	13-7
13.2.3 Affected Environment: Unocal Treatment Plant	13-7
13.2.3.1 Observation Point 1.....	13-9
13.2.3.2 Observation Point 2.....	13-9
13.2.3.3 Observation Point 3.....	13-9
13.2.3.4 Observation Point 4.....	13-9
13.2.3.5 Observation Point 5.....	13-9
13.2.3.6 Observation Point 6.....	13-10
13.2.4 Affected Environment: Route 9 and Unocal Conveyance Corridors	13-10
13.2.5 Affected Environment: Route 9 and Unocal Outfall	13-10
13.3 Impacts and Mitigation	13-20
13.3.1 Study Methodology.....	13-20
13.3.2 Impacts and Mitigation Common to All Systems.....	13-21
13.3.2.1 Treatment Plant Impacts Common to All Systems.....	13-21
Construction Impacts Common to All Systems: Treatment Plant.....	13-21
Operation Impacts Common to All Systems: Treatment Plant	13-22
Proposed Mitigation Common to All Systems: Treatment Plant	13-23
13.3.2.2 Conveyance Impacts Common to All Systems.....	13-23
Construction Impacts Common to All Systems: Conveyance.....	13-23
Operation Impacts Common to All Systems: Conveyance	13-24
Proposed Mitigation Common to All Systems: Conveyance	13-24
13.3.2.3 Outfall Impacts Common to All Systems	13-24
Construction Impacts Common to All Systems: Outfall	13-24
Operation Impacts Common to All Systems: Outfall	13-25
Proposed Mitigation Common to All Systems: Outfall.....	13-25
13.3.3 Impacts and Mitigation: Route 9 System.....	13-25
13.3.3.1 Treatment Plant and Conveyance: Route 9.....	13-25
Construction Impacts: Route 9 Treatment Plant and Conveyance	13-25
Operation Impacts: Route 9 Treatment Plant and Conveyance.....	13-29
Proposed Mitigation: Route 9 Treatment Plant and Conveyance.....	13-30
13.3.3.2 Outfall: Route 9.....	13-30
13.3.4 Impacts and Mitigation: Unocal System.....	13-30

13.3.4.1	Treatment Plant and Conveyance: Unocal.....	13-30
	Construction Impacts: Unocal Treatment Plant and Conveyance	13-30
	Operation Impacts: Unocal Treatment Plant and Conveyance.....	13-30
	Proposed Mitigation: Unocal Treatment Plant and Conveyance.....	13-34
13.3.4.2	Outfall: Unocal.....	13-34
13.3.5	No Action Alternative.....	13-34
13.3.6	Cumulative Impacts	13-34
13.4	Significant Unavoidable Adverse Impacts.....	13-35
13.5	Summary of Impacts and Mitigation	13-36
13.6	References.....	13-41

List of Tables

Table 13-1.	Typical Lighting Levels in Outdoor Areas	13-5
Table 13-2.	Measured Lighting Levels at the Route 9 Treatment Plant Site	13-6
Table 13-3.	Measured Lighting Levels at the Unocal Treatment Plant Site	13-8
Table 13-4.	Existing Conditions at Primary Candidate Portal Sites on the Route 9 Corridors	13-11
Table 13-5.	Existing Conditions at Primary Candidate Portal Sites on the Unocal Corridor...	13-18
Table 13-6.	Recommended Pre- and Post-Curfew Lighting Levels (in lux).....	13-20
Table 13-7.	Potential Impacts at Primary Candidate Portal Sites on the Route 9 Corridors	13-26
Table 13-8.	Potential Impacts at Primary Candidate Portal Sites on the Unocal Corridor.....	13-31
Table 13-9.	Summary of Potential Light and Glare Impacts and Proposed Mitigation for Brightwater Systems	13-37

Chapter 13

Light and Glare

13.1 Introduction

This chapter addresses the affected environment, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to light and glare for the Brightwater System. References and figures cited herein can be found at the end of the chapter.

13.1.1 Overview of the Chapter

This chapter has been summarized to focus on relevant findings and conclusions of the light and glare analysis. Brief discussions of applicable regulations and the methods used for analysis are provided to give the reader context for the discussion of impacts. Detailed descriptions of the evaluation and results are included in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants, while important conclusions are provided in summary form in this chapter.

Comments on the Draft EIS were received from state and local agencies, public interest groups, and individuals. The majority of the comments fell into seven main categories:

1. Provide a three-dimensional model of the site lighting
2. Classify the Unocal site surrounding area
3. Include the City of Woodinville and Woodway's Codes and Resolutions
4. Delete references and comparisons to the Unocal tank farm
5. Ensure that design blocks the downhill residences from light and glare at the Unocal site
6. Provide field light data collected
7. Address construction impacts due to the long construction duration

In response to the comments, additional details are provided in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants, and Appendix 13-B, Light and Glare: Conveyance. Appendix 13-A includes three-dimensional models for both the Route 9 and Unocal sites. For the Unocal site, both the lidded multimodal and unlidded alternatives were modeled to show an ultimate built-out configuration. Appendix 13-B includes details on the conveyance system. Tables were added to this

chapter summarizing the land usage and existing lighting at each portal site. This is described in further detail in Appendix 13-B.

13.2 Affected Environment

This section describes the current light and glare conditions at the plant and portal sites of the Brightwater System. The current light and glare conditions are described specifically for the Route 9 and Unocal treatment plant sites and generally for the conveyance corridors (including portal siting areas) and outfall zones.

Light and glare issues related to outfall construction are similar to those of the treatment plant and conveyance corridors. However, outfall operation is not anticipated to cause any light and glare impacts. Conveyance facility operation would generate minimal lighting increases; however, construction of portals, a pump station, or the outfall could occur during hours of darkness, requiring lighting. Because final portal locations have not been determined within the portal siting areas, it is difficult to quantify light and glare impacts. Accordingly, construction-related light and glare impacts at portals and the pump station are discussed as a worst-case scenario.

13.2.1 Affected Environment Common to All Systems

13.2.1.1 Regulatory Environment

Local development codes were reviewed to identify requirements related to light and glare. The relevant codes are:

Route 9 Site:

- Snohomish County Code Title 30

Unocal Site:

- Edmonds Municipal Code Titles 16 and 17

Conveyance Corridor:

- Bothell Municipal Code Title 8
- Kenmore Municipal Code Title 18, Lake Forest Park City Code Title 18, Mountlake Terrace Municipal Code Title 19
- Woodinville Municipal Code Title 21

In addition, relevant codes and resolutions of jurisdictions neighboring the two treatment plant sites were reviewed. They are:

Route 9 Site:

- Woodinville Municipal Code Title 19

Unocal Site:

- City of Woodway Resolution Numbers 41 and 49

In general, regulations pertaining to light and glare are limited in these codes, and quantitative standards are lacking. The Snohomish County Code states only that lighting shall be hooded or shielded to protect surrounding properties or rights-of-way from glare. The Edmonds Code states that “all exterior lighting shall be arranged and directed so as to direct the light away from adjacent residential areas.” The other codes are similarly unspecific except for Bothell’s and Woodinville’s. Bothell restricts exterior lighting to 1 foot-candle (10 lux) 5 feet aboveground across a property line in a residential zone. Woodinville adopts the recommendations of the *IESNA Lighting Handbook* of the Illuminating Engineering Society of North America (IESNA, 2000). None of these codes include provisions for regulating illumination during construction.

In the absence of more specific regulations, IESNA’s RP-33-99 (IESNA, 1999), consistent with the *IESNA Lighting Handbook*, provides guidelines to minimize light and glare associated with exterior lighting. It also recommends pre-curfew and post-curfew light levels for various types of surroundings. Pre-curfew is defined as the period from sunrise to 10 p.m.; post-curfew is from 10 p.m. to sunrise.

In addition to the regulations presented above, the Washington Industrial Safety and Health Act (WISHA) has regulations regarding worker safety. WISHA requires that a contractor provide and maintain adequate lighting for all work activities. For details, see Appendix 13-B, Light and Glare: Conveyance.

13.2.1.2 Light and Glare Sources and Measurement

Both the Route 9 and Unocal sites were evaluated for existing light and glare sources. These sources are either located on the sites or visible from the sites. Observations were also made about what is visible from the site and how lighting from within the site would affect the surrounding areas. Each site was visited during daylight hours to assess the topography, determine existing known sources of light, and establish the best locations for nighttime readings and observations.

The methods used were the same for both sites. Ambient light levels were measured at both sites on the night of July 24, 2002, to establish baseline values using an EXTECH foot candle/lux light meter with an illuminance head. The EXTECH meter can measure values as low as 1 lux. Measurements at each observation point were taken vertically,

with the light meter facing the project sites (perpendicular to the ground or a “vertical” measurement), and horizontally, with the light meter facing up (parallel to the ground or a “horizontal” measurement).

Light levels typically are measured in terms of a unit value known as a lux. One lux is defined as 1 lumen per square meter (lm/m^2). There are 10.76 lux per foot-candle. By definition, 1 foot-candle is the illumination cast by a candle flame on a 1-square-foot surface located 1 foot from the candle.

Natural conditions have an effect on the ambient light level. Therefore, the conditions at the time of the fieldwork were recorded. Sunset occurred at 8:53 p.m. and moonrise at 9:41 p.m. The moon was full. The weather was clear. The daily temperature range was from 60 degrees Fahrenheit ($^{\circ}\text{F}$) to 85 $^{\circ}\text{F}$. Visibility was in excess of 10 miles when the light observations were made. Retesting after project completion should be conducted under similar conditions. This will help minimize variables that may alter the findings. These variables could include a no moon versus full moon, cloud cover that reflects light from surrounding areas back into the site, or wet surfaces from rain that will result in a higher surface reflectance value.

A total of 11 observation points were selected to establish baseline light levels—6 at the Unocal site (observation points 1 through 6 are shown on Figure 13-1) and 5 at the Route 9 site (observation points 7 through 11 are shown on Figure 13-2). The observation points were selected because they offered a view of a portion of the project sites and allowed for easy measurement of post-construction light levels. At each observation point, the light meter sensing head was mounted on a tripod. Measurements were then taken with the head oriented vertically facing each of the cardinal directions. A measurement was also taken with the sensing head facing up, parallel to the ground. Other measurements were taken to measure individual sources of light. The first of these measurements was taken 1 hour after sunset, with the last measurement taken just after midnight of the same night.

Light levels typically encountered in different outdoor and indoor areas are shown in Table 13-1. This is included as a point of reference, and to provide values to be used for comparison for what was found at the sites and what is being proposed for the site illumination.

Observation point locations and monitoring results for each treatment plant site are summarized below.

Table 13-1. Typical Lighting Levels in Outdoor Areas

Area	Illumination Level (lux)
Outdoor open area	2
Pavement illuminated residential street	4
Pavement illuminated supermarket parking lot	10
Surveillance lighting—Pedestrian/vehicle entrances	10
Sidewalks/bikeways/residential areas	10
Pavement illuminated city street	15
Pavement illuminated city street intersection	30
Parking lots—Open, medium activity	6
Parking lots—Covered, general parking	54
Tennis court—Outdoor tournament	1000
Tennis court—Outdoor recreational	100
Courtroom—Seating area	100–200
Courtroom—Court activity area	500–1000
Office—Reading, casual, desk elevation	200–500

13.2.2 Affected Environment: Route 9 Treatment Plant

The Route 9 site is located in an area occupied by various businesses including auto salvage, business park, and professional buildings. The Route 9 site is illuminated with multiple sources of light; although the light is visible, the levels are low and, in general, below the level perceptible by the light meter as observed during the time of this study.

Table 13-2 contains field data for each of the observation points at the Route 9 site, which are shown in Figure 13-2. All of the fieldwork was completed in a single visit. The first observation was 1 hour after sunset, and the final observation was just after midnight.

Table 13-2. Measured Lighting Levels at the Route 9 Treatment Plant Site

Reading No.	Orientation ^a (H/V)	Bearing (degrees)	Tilt (degrees)	Reading (lux)	View
Observation Point 7					
1	H	N/A	90	1	
2	V	0	0	2	Facing SR-9
3	V	180	0	0	Facing railroad tracks
4	V	90	0	0	Direction of the site
5	V	270	0	4	Facing StockPot Culinary Campus
Observation Point 8					
1	H	N/A	90	0	
2	V	0	0	0	Facing wetland to the north
3	V	180	0	1	Along road facing site
4	V	90	0	0	Facing SR-9
5	V	270	0	1	Facing StockPot Culinary Campus
Observation Point 9					
1	H	N/A	90	0	
2	V	60	0	0	Away from site
3	V	240	0	0	Direction of the site
4	V	140	0	0	Direction of the site and railroad
5	V	320	0	0	Direction of SR-9
Observation Point 10					
1	H	N/A	90	1	
2	V	0	0	1	SR-9
3	V	180	0	1	SR-9
Observation Point 10					
4	V	90	0	0	Away from the site (up 228th)
5	V	270	0	3	Direction of the site
Observation Point 11					
1	H	N/A	90	0	
2	V	0	0	0	SR-9
3	V	180	0	0	SR-9
4	V	90	0	0	Away from the site
5	V	270	0	1	Direction of the site

^aH=horizontal; V=vertical

13.2.2.1 Observation Point 7

Observation Point 7 is located at the end of the road on the south side of the StockPot Culinary Campus (Figure 13-2). Lights from the StockPot building and parking area as well as from surrounding businesses and roadways are visible at this location.

13.2.2.2 Observation Point 8

Observation Point 8 is located at the north end of the road in front of the StockPot Culinary Campus. From this location, lights from the StockPot building and parking area as well as from surrounding businesses and roadways are visible.

13.2.2.3 Observation Point 9

Observation Point 9 is located north of the industrial complex along SR-9 and the short gravel road on the east side of the highway. Lights from the StockPot Culinary Campus and other surrounding businesses are visible at this location.

13.2.2.4 Observation Point 10

Observation Point 10 is located at the intersection of SR-9 and 228th Street SE, on the west side of the intersection. Lights from SR-9 and from many illuminated business signs are visible from this location.

13.2.2.5 Observation Point 11

Observation Point 11 is located on the west side of the intersection of SR-9 and 233rd Place SE. Lights from SR-9 and from many illuminated businesses signs are visible from this location. It also appears that there are some adjacent street lights that were not working at the time of the observation.

13.2.3 Affected Environment: Unocal Treatment Plant

The Unocal site is located on a hillside formerly occupied by the Unocal tank farm and associated facilities. Presently there are very few active, visible light sources within the site, as observed from the surrounding area. The Unocal site is not currently lighted, as observed during the time of this study.

Table 13-3 contains field data for each of the observation points at the Unocal site, shown on the map in Figure 13-1. All of the fieldwork was completed in a single visit. The first observation was 1 hour after sunset, and the final observation was just after midnight.

Table 13-3. Measured Lighting Levels at the Unocal Treatment Plant Site

Reading No.	Orientation ^a (H/V)	Bearing (degrees)	Tilt (degrees)	Reading (lux)	View
Observation Point 1					
1	H	N/A	90	0	
2	V	120	0	0	Up road toward site
3	V	60	0	0	Dock/dry storage
4	V	0	0	0	Puget Sound
5	V	180	0	0	Hillside/tree buffer
Observation Point 2					
1	H	N/A	90	1	
2	V	0	0	2	Parking areas
3	V	60	0	1	Boat storage
4	V	120	0	3	Site, boat storage
5	V	180	0	4	Boat dry storage
Observation Point 3					
1	H	N/A	90	2	
2	V	60	0	3	All directions other than reading 4 were facing buildings and other developed areas surrounding the buildings
3	V	120	0	1	
4	V	180	0	0	Direction of the site
5	V	240	0	3	
Observation Point 4					
1	H	N/A	90	0	
2	V	0	0	0	Away from the site
3	V	300	0	0	
4	V	180	0	0	Direction of the site
5	V	90	0	0	
Observation Point 5					
1	H	N/A	90	0	
2	V	0	0	0	North edge of existing site, fence
3	V	300	0	0	Direction of the site
4	V	180	0	0	Away from site (Woodway)
Observation Point 6					
1	H	N/A	90	0	
2	V	0	0	0	
3	V	300	0	0	Direction of the site
4	V	240	0	0	South edge of the site
5	V	120	0	0	Direction of the residential area

^aH=horizontal; V=vertical

13.2.3.1 Observation Point 1

Observation Point 1 is located at the end of Admiral Way at the turnaround point (Figure 13-1). From this location the project site is visible, as are a public park, marina, boat storage yard, and the Unocal Pier. No lights were visible within the Unocal site during the site visit. There is a tree buffer just east of the railroad tracks that blocks most of the site from view. Lights at the marina and boat storage area were visible.

13.2.3.2 Observation Point 2

Observation Point 2 is located at the stop sign on Admiral Way just north of the boat dry storage yard. From this location, the Unocal site is visible to the southeast. Many sources of light were visible at this location, including street lights along Admiral Way, parking lot lights, and marina lights. The visible portion of the site appeared dark from this location.

13.2.3.3 Observation Point 3

Observation Point 3 is located near two tennis courts by an athletic club. The Unocal site is largely obscured from this location due to landscaping, and the area in the direction of the Unocal site was dark. Lights were visible in the adjacent parking lots and on the buildings as well as from the marina area.

13.2.3.4 Observation Point 4

Observation Point 4 is located at the intersection of Pine Street and Union Oil Company Road. From this location the visible sources of light consisted of the street light at the intersection, a stop light at the entrance of the Unocal site, and the marina lights.

13.2.3.5 Observation Point 5

Observation Point 5 is located at the intersection of Pine Street and Nootka Road, an entrance to the Town of Woodway. From this location, the visible sources of light consisted of the marina lights beyond the project area. There were a large number of existing floodlights in the project site that are not operating at this time. (It is reported that these have not been operating for many years, and will not be re-energized in the future.)

13.2.3.6 Observation Point 6

Observation Point 6 is located at the intersection of Pine Street and 216th Street SW, an entrance to the town of Woodway. From this location, sources of light consisted of ferry lights and a visible glow from the Edmonds area. Between this location and observation point 5, there was a view of the City of Edmonds with many visible sources of light.

13.2.4 Affected Environment: Route 9 and Unocal Conveyance Corridors

Existing lighting levels along the corridors vary widely, depending on land uses and activities. Some streets currently have no lighting; others have commercial or industrial lighting levels or are adjacent to ballparks that have lighting systems for night games. For a detailed discussion of lighting levels along the corridors, see Appendix 13-B, Light and Glare: Conveyance.

Table 13-4 (Route 9) and Table 13-5 (Unocal) summarize the information for each primary portal, the adjacent land use, and the existing lighting. Similar information on secondary portals is included in Appendix 13-B.

Portal 41 Influent Pump Station Option

The affected environments for the Route 9–195th Street corridor and Route 9–228th Street corridor IPS Option are the same as that described for Portal 41 in Table 13-4.

13.2.5 Affected Environment: Route 9 and Unocal Outfall

Similar to conveyance corridors, marine outfall zones vary in their existing lighting levels, depending upon land uses and activities. Existing lighting sources at the Route 9 outfall (Zone 7S) include the Chevron Richmond Beach Asphalt Terminal. Existing lighting sources for the Unocal outfall (Zone 6) include the Port of Edmonds and Marina Park.

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
195th Street corridor				
Portal 11				
A	Light industrial and commercial area having retail/business north of NE Bothell Way	Low area with gentle slope uphill to the northeast	Area with commercial and light industrial buildings and no trees onsite, and very open area, few trees around the site	Street lighting on NE Bothell Way and Juanita Drive NE; minimal, if any, lighting for commercial/industrial buildings and parking lots; no street lighting on NE 175th St. in proximity of the site
B	Light industrial and commercial area having retail/business north of NE Bothell Way	Located in a low area on a gentle slope uphill to the northeast	Area with commercial and light industrial buildings, unpaved parking lot, a few small deciduous trees (approx. height 20-30 ft) along southern and southwestern site borders	Street lighting on NE Bothell Way and Juanita Drive NE; minimal, if any, lighting for commercial/industrial buildings and parking lots; no street lighting on NE 175th St. in proximity of the site
C	Urban commercial areas surround the site with residential area to northwest	Gentle slope uphill to the northwest	Parking lot with buildings on the north and east side, a few small deciduous trees along NE 181st St.	Street lighting and lighting associated with buildings and parking lots
Portal 44				
C	Rural and residential and forested, buildings adjacent northwest and southwest	On steep slope uphill to the east	Dense wooded area – deciduous/evergreen mixture (approx. height 100+ ft)	Minimal street lighting on 80th Ave. NE
D	Rural and residential, forested, no apparent buildings immediately adjacent to property	Western portion flat; eastern third of site slopes slightly uphill to the east	Open field with horse barn and houses, mostly deciduous trees on site borders (approx. height 20-100 ft) forming a potential screen from adjacent properties, dense wooded area to the north, east, and south of site	Minimal street lighting on 80th Ave. NE, no street lighting on NE 195th St.

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
Portal Siting Area 44				
E	Rural and residential to the south and west with open space to the north and forested to the east	Moderate slope uphill to the west, on higher ground than NE 195th St. and adjacent residences	Southeastern portion contains a mixture of evergreen (approx. height 5-30 ft) and deciduous (approx. height 20-40 ft), western portion contains few trees, trees form a potential screen on all borders except south (along NE 195th St.)	No street lighting on NE 195th St.
Portal Siting Area 41				
A	Urban commercial (office park)	Flat	Interior of site is asphalt with concrete footings and contains no trees; perimeter lined with trees forming a potential screen for adjacent properties; northern edge is a mixture of evergreen (approx. height 10-20 ft) and deciduous (approx. height 10-50 ft); eastern edge is a mixture of evergreen (approx. height 30-50 ft) and deciduous (approx. height 100 ft); southern and western edges are a mixture of evergreen/deciduous (approx. height 30-50 ft)	Adjacent office parking lots are lit; street lighting on North Creek Parkway and NE 195th St.
C	Urban commercial (office park) to the north, south, and west, residential to the east, ball field to the southwest	Moderate uphill to the east, steep uphill just offsite to the east	Dense woods in southeastern portion – mixture of evergreen (approx. height 40-50 ft) and deciduous (approx. height 30-100 ft); grassy park area in northwestern portion with few trees (approx. height 20-30 ft) - mostly deciduous and a few evergreen	Adjacent office parking lots are lit; lighting along access drive but no onsite lighting

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
D	Urban commercial (office park), grassy park area to the northeast	Flat	Baseball diamond; trees line perimeter of site; northern and eastern edges contain deciduous trees (approx. height 20-25 ft); southern and western edges contain a mixture of evergreen/deciduous (approx. height 40-50 ft), trees form a potential screen along southern and western borders	Eight large baseball diamond light towers, adjacent office parking lots are lit, street lighting on adjacent roads, the site has a ball field with lights
Portal Siting Area 41				
X	Light industrial	Flat	North Creek Pump Station	Minimal lighting at the pump station
W	Residential with some open space	Slopes uphill to the west	Dense evergreen (approx. height 40-80 ft) along west side of the site forming potential screen; mixture of deciduous and evergreen (approx. height 20-60 ft) along south and southwest side of the site	Street lighting on Beardslee Blvd.
J	Commercial office-park; vacant site to the north ready to be developed	Flat; manmade stormwater drainage channel on the southeast side of the site	Few scattered shrubs and trees (mostly deciduous) along the perimeter of the site; northern and western border of the site has some evergreen trees (~20 feet) forming partial screen; southeastern side contains a mixture of evergreen and deciduous trees	Adjacent office parking lots are lit; street lighting on North Creek Parkway and NE 195th Street

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
Portal Siting Area 5				
B	Commercial to the northwest, southeast, and northeast along Ballinger Way NE, residential along the southern half of site	Gentle uphill to the northeast	Mostly impervious area- parking lot, storage and sales buildings; conifer trees run along perimeter of southwestern border (approx. height 100 ft) forming a potential screen	Street lighting on Ballinger Way NE, parking lot onsite has no lighting
G	Commercial to the northwest, southeast, and northeast along Ballinger Way NE	Gentle uphill to the northeast	Mostly impervious area- parking lot, storage and commercial buildings, conifer trees run along perimeter of southwestern border (approx. height 100+ ft) forming a potential screen	Street lighting on Ballinger Way NE, parking lot lighting
X	Commercial to the north, and southeast along Ballinger Way NE, residential to the south	Flat	Gas station in northwest portion, Commercial service in southeast portion; mostly impervious area; some evergreen trees along southern edge and deciduous trees between parcels (approx. height 30 ft)	Street lighting on Ballinger Way NE, significant lighting (light poles and floodlights) at the site
Portal Siting Area 19				
C	Industrial to the north, residential to the south and southeast, ocean to the west, wooded area to the northwest	Flat and barely above sea level with steep uphill slope just offsite to the east	Site is on land fenced off as part of industrial facility; small deciduous trees (approx. height 30 ft) lining above roadway, portion east of Richmond Beach Drive NW is mostly impervious – building and parking lot with a few small scattered deciduous and evergreen trees (approx. height 15-30 ft)	Street lighting along Richmond Beach Drive NW, industrial facility near the site has lighting

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
228th Street corridor				
Portal Siting Area 11				
Same as 195th Street Alternative				
Portal Siting Area 44				
Same as 195th Street Alternative				
Portal Siting Area 41				
Same as 195th Street Alternative				
Portal Siting Area 39				
B	Rural and residential west, south, and east, office buildings and light industrial across 228th St. SE to the north	Gentle slope with hill rising to the northeast	Northern portion is mainly deciduous trees (approx. height 30-100+ ft); southwestern portion becomes predominantly evergreen trees (approx. height 70-125 ft); western portion is densely wooded; eastern portion is residential and contains few trees, trees form a potential screen in western portion	Minimal street lighting on 228th Ave. SE
Portal Siting Area 39				
C	Rural and residential surrounding the site, there are buildings adjacent to the site on the west side and open space to the southwest	On hill side, gentle slope uphill to the northeast	Southwestern portion of site contains deciduous trees (approx. height 50-60 ft); northwestern portion contains a mixture of evergreen trees (150 ft) and deciduous trees (approx. height 80-100 ft); clearing in center portion of site; trees form a potential screen along eastern and southern site borders	Minimal street lighting on 31st Ave. SE

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
D	Rural and residential with an adjacent building north, additional open space to the south	Gentle slope in a low spot between hills	Site contains few trees; a few deciduous trees in center (approx. height 100+ ft); small deciduous and shrubbery for landscaping use line property edges	Minimal street lighting on 31st Ave. SE and 228th Ave. SE
Portal Siting Area 33				
A	Rural and residential area	Moderate slope uphill to west	Mature trees deciduous/evergreen mixture (approx. height 100-150 ft) in northern portion; mainly evergreen trees (approx. height 50-100 ft) scattered along western boundary; southern portion is cleared with houses, horse pasture, and private roads; trees form a screen to the north and possibly to the west	No street lighting in vicinity of site; street lighting at intersection
C	Rural and residential	Mostly flat	Mixture of evergreen/deciduous trees (approx. height 100-150+ ft) along western border; deciduous trees (approx. height 100 ft) along northern and eastern border; few trees within interior portion of site; trees form a potential border to east, north, and west	Street lighting along 228th St. SW
D	Rural and residential	In low valley, slight slope uphill to northeast	Mature wooded area, mainly deciduous trees (approx. height 100+ ft) and a few scattered evergreens; clearing in center of site extending north, trees form a potential screen on southern and western borders	No lighting in vicinity of site; street lighting at intersection of Locust Way and 228th St. SW

**Table 13-4. Existing Conditions at Primary
Candidate Portal Sites on the Route 9 Corridors (cont.)**

Candidate Portal Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
Portal Siting Area 26				
A	Residential with open space to the south	Hill to the east, relatively flat north, south, and west	Soccer field, park and park buildings, deciduous trees (approx. height 50 ft) along western border form a potential screen for adjacent property; a few evergreens trees in far northwest corner of site (approx. height 50-100 ft)	Street lighting on Lakeview Drive, ball field has no lighting
C	Commercial to the north, south, and west along SR-99, residential to the east	Gentle slope uphill to northwest, surrounding area is free of large hills	Site is mostly asphalt parking lot/driveway with large strip mall and small strip mall on perimeter, half of the large strip mall is being remodeled, very few trees	Street lighting on SR-99, onsite parking lot has no lighting, adjacent parking lots have lighting
D	Residential to the north, west, and south, ball field is to the southwest and trees to the east	Hill to the east, relatively flat north, south, and west	Dense wooded area – mostly mature evergreen and a few deciduous trees (approx. height 100-150 ft); trees are in a corridor, interrupted by power lines	Street lighting along 228th St. SW
Portal Siting Area 19				
Same as 195th Street Alternative				

Table 13-5. Existing Conditions at Primary Candidate Portal Sites on the Unocal Corridor

Candidate Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
Portal Siting Area 3				
D	Single-family residential	Gentle slope to the southwest	Stand of evergreens runs along Edmonds Way from southeast to northwest; site is predominantly evergreen trees (approx. height 125 ft) with a few scattered deciduous trees (approx. height 75 ft)	Lights along east perimeter of the site (Edmonds Way)
E	Rural residential with commercial to the north	Gentle slope uphill to the south, located in a low spot	Site is predominantly evergreen trees (approx. height 150 ft) with scattered deciduous trees (approx. height 60-80 ft); trees form potential screen on western and southern borders	Minimal street lighting along 92nd Ave. W, parking lot light in veterinary clinic, lighting along Edmonds Way
F	Rural residential with trees to the north, east and west, rural residential to the south	Moderate slope uphill to southwest	Forested site – mainly deciduous trees (approx. height 60-80 ft), evergreen trees concentrated in southwest corner (approx. height 100 ft); blackberry bushes and trees to the north, east, and west	Minimal street lighting at intersection of 92nd Ave W and 234th St. SW
Portal Siting Area 7				
A	Residential with some trees, school to the north, King County shop to the west	Track and field in northeast corner raised (approx. height 20 ft) above baseball diamond and tennis court in west/southwest portion; uphill slope to the northeast	Baseball diamond in southwest corner, tennis court in northwest corner, track and field raised in northeast corner; fir trees (approx. height 50-70 ft) on southern and eastern site borders form a potential screen from adjacent properties; deciduous trees in northeast portion (approx. height 70-100 ft)	25th Ave. NE has no street lighting, Ballinger Rd. NE has residential street lighting; lighting at Ballinger/25th Ave. intersection; no lighting on ball field
B	Residential, school to the northeast, ball field to the east, bog and park to the north	Sharp incline on southwest border	Mostly deciduous trees along western and northern borders of site that form a potential screen from adjacent properties	25th Ave. NE has no street lighting, Ballinger Rd. NE has residential street lighting, lighting at Ballinger/25th Ave. intersection; no lighting on ball field
C	Residential with some trees, school to the northeast, ball field to the east, King County shop to the south	Varied, stream runs north to south dividing park in half	Park and bog area containing playground; mixture of coniferous and deciduous trees (approx. height 60 –100 ft)	25th Ave. NE has no street lighting; Ballinger Rd. NE has residential street lighting; lighting at Ballinger/25th Ave. intersection; no lighting on ball field

Table 13-5. Existing Conditions at Primary Candidate Portal Sites on the Unocal Corridor (cont.)

Candidate Site	Adjacent Land Use	Topography	Site Specific Comment	Existing Lighting
Portal Siting Area 11				
Same as 195th Street Alternative				
Portal Siting Area 14				
A	Urban commercial (office park)	Flat	Site is a baseball diamond with floodlights and paved pedestrian trail around the complex; deciduous trees along western and northern borders; evergreen trees along eastern border; evergreen/ deciduous mixture along southern border (approx. height 30-50 ft)	Street lighting along North Creek Parkway; site is a ball field with floodlights
B	Urban commercial (office park)	Flat	Site is a baseball diamond with floodlights and paved pedestrian trail around the complex; deciduous trees along western (approx. height 70 ft) and southern borders (approx. height 25-30 ft); evergreen/ deciduous mix along eastern border (approx. height 40 ft); all borders except northern may provide a screen for adjacent properties	Street lighting along North Creek Parkway, site is a ball field with floodlights
D	Urban commercial (office park), Industrial	Flat	Evergreens (20 ft) along southern border and surrounding substation; deciduous within interior area (approx. height 10-12 ft) and along western border (120th Ave NE); trees form a potential screen on all but northern edge	Street lighting along 120th Ave. NE., lighting along adjacent driveway

13.3 Impacts and Mitigation

Following is a discussion of the anticipated impacts and proposed mitigation associated with the Route 9 and Unocal System alternatives.

13.3.1 Study Methodology

Adverse effects of light and glare generally are attributable either to a substantial increase in ambient light levels at locations near the light source or to the visual impact of a new light source in a previously unlighted area as viewed from locations distant from the light source. For example, if bright lights are used, the resulting glare could affect locations near the light source due to a significant increase in light levels in the area. Locations distant from a bright light source may experience adversely affected views due to glare extending outward from the light source similar to the glare effect of an outdoor illuminated stadium, a phenomenon known as “sky glow.”

The evaluation of light and glare impacts was based upon guidelines for evaluating exterior lighting impacts published by IESNA. The IESNA guidelines define recommended post-construction lighting levels based upon existing light levels in the potentially affected area. IESNA’s recommended practice RP-33-99, *Lighting for Exterior Environments* (IESNA, 1999), defines four categories for evaluating light impacts for pre- and post-construction conditions:

1. E1—Areas with intrinsically dark landscapes
2. E2—Areas with low ambient brightness
3. E3—Areas with medium ambient brightness
4. E4—Areas with high ambient brightness

Based upon the field observations conducted for this EIS, the Route 9 site would be classified as E2 and the Unocal site as E3. The guidelines describe E2 areas as “typical outer urban or rural areas,” and E3 areas as “urban residential areas.” The recommended pre-curfew and post-curfew lighting levels (in lux units) for each area are shown in Table 13-6.

Table 13-6. Recommended Pre- and Post-Curfew Lighting Levels (in lux)

Category	Pre-Curfew ^a	Post-Curfew ^a
E1	1	0
E2	3	1
E3	8	2
E4	15	6

Note: Values are with the light meter facing the light source.

^a “Pre-curfew” is from sunrise to 10 p.m.; “post-curfew” is from 10 p.m. to sunrise.

To limit impacts on surrounding communities, King County has committed to meeting or exceeding the IESNA standards. On this basis the treatment plant sites have been modeled for nighttime (pre-curfew) illumination even though specific lighting methods and locations have not yet been designed. The following assumptions were used for the modeling:

- The luminaires modeled are typical of the type, style, and quality of lighting for treatment plants
- The building configurations and heights represent those planned
- Illumination will be to levels required for personnel safety and operations
- Design of lighting would incorporate the mitigation measures described in this Impacts and Mitigation section
- Modeling was only done at the treatment plant sites, not at the portal sites. This is because the treatment plant sites created a larger impact due to the size of the sites and because the portal locations have not been finalized. Portal sites will be modeled during the permitting process. Site lighting did not include offsite, existing, or proposed street lighting adjacent to the sites. Lighting was included at all site entrances

The methodology and results of the illumination modeling are given in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants.

13.3.2 Impacts and Mitigation Common to All Systems

This section describes the impacts on the environment that may result from construction and operation of the Brightwater System action alternatives.

13.3.2.1 Treatment Plant Impacts Common to All Systems

Construction Impacts Common to All Systems: Treatment Plant

Although project construction activities would take place as much as possible during daylight hours, some work at the treatment plant sites (particularly during winter months) would require the use of supplemental lighting. In addition, security lighting would be required at all times during nighttime hours to ensure safety. Construction lighting must be sufficiently bright to illuminate work areas and could therefore cause temporary significant increases in light and glare levels at the observation points identified for this evaluation during nighttime construction. These impacts would be limited to the construction period (up to 5 years) and would be minimized by the use of downcast lighting fixtures and other measures to shield light sources. Security lighting would be

provided at low levels and is not expected to cause a net increase in ambient light levels at the observation points.

Operation Impacts Common to All Systems: Treatment Plant

Operation of the Brightwater Treatment Plant would introduce new light sources into areas that presently have a range of sources of artificial illumination. The potential effects of the lighting associated with operation of the Brightwater Treatment Plant would include a change in the existing lighting pattern that is visible from areas distant from the plant. Operational lighting would be required because the treatment plant would operate 24 hours per day. Lighting systems for exterior ancillary components, such as walkways and other areas for worker safety and security, would be designed and installed to meet industry-recommended minimum lighting levels, as required by WISHA.

As noted above, lighting at the plant would be designed so as not to exceed the IESNA guideline for Area E3 and E2 sites for Unocal (8 lux pre-curfew and 2 lux post-curfew) and Route 9 (3 lux pre-curfew and 1 lux post-curfew), respectively. Lighting systems would also be designed so that they generate lighting patterns similar to the existing lighting patterns in the surrounding communities. Hence, in general there would be no significant onsite illumination. The types of lighting would be selected so as not to cause significant differences from existing conditions. All lighting would be designed to conform to the recommendations of RP-33-99 (IESNA, 1999), and to the International Dark-Sky Association (IDA, 2000). Higher levels of illumination for critical facilities would be required under emergency situations; however, it is anticipated that most areas that would require emergency access would be located within structures and, consequently, would not increase external light levels.

Implementation of the mitigation measures described below would minimize the visual impacts to surrounding areas. After construction, the measurable light levels in the area surrounding the project site would be less than the values listed in RP-33-99: Zone E3 for the Unocal site and Zone E2 for the Route 9 site. Light conditions after construction should be retested under conditions similar to those during the initial testing.

Although the project site would be illuminated and visible from outside the project boundaries, the light levels would be decreased after 10 p.m. Safety and security lighting, however, would remain on from dusk to dawn.

Based on the assumed mix of materials that would be used around the site, it is estimated that the overall potential for light reflectance at the project site would be approximately 10 to 20 percent. The Brightwater Treatment Plant would use low-level lighting under normal operation. The potential for glare attributable to a bright lighting system would be reduced. The use of varied and textured surfaces on the buildings and grounds (such as plantings versus concrete or asphalt) will help scatter the reflected light and lessen the appearance of sky glow from the site lighting.

Proposed Mitigation Common to All Systems: Treatment Plant

Proposed mitigation to reduce light and glare impacts at both sites could include:

- Using luminaires with cutoff optics. Cutoff optics direct the light downward, with no visible source of light above 90 degrees
- Providing dusk-to-dawn lighting only in areas where it would be required for safe egress and operator safety. Reduce light levels after 10 p.m. to the minimum levels required for security and safety
- Providing switchable task lighting in areas where detailed inspections will be required after dusk
- Limiting luminaire mounting height to 30 feet, where practical
- Limiting outdoor lamp wattage to 250 watts, except for switched task lights
- Avoiding the use of floodlighting
- Using cutoff-type lights around the perimeter of areas that require lighting; aim these lights toward the site and away from the surrounding areas. If necessary, add “house-side” shields to further minimize the light intrusion to offsite properties

13.3.2.2 Conveyance Impacts Common to All Systems

Construction Impacts Common to All Systems: Conveyance

Impacts during construction of the conveyance pipelines would be similar to those described above for the treatment plant. It is anticipated that construction at the portal and pump station locations could occur during evening hours, requiring construction lighting at the sites. This would result in temporary light and glare impacts to surrounding land uses, particularly where portals are located in residential areas. The impacts could be potentially significant during the construction period.

Final portal sites would be selected with the intention of minimizing impacts to surrounding neighborhoods; however, it would not likely be possible to avoid all potential light and glare impacts. Lighting levels could reach a maximum of 2 lux at the property line. King County will work with potentially affected neighborhoods to identify appropriate mitigation measures and will employ specific mitigation measures as described in the mitigation section of this chapter to minimize the impacts to affected residences.

Operation Impacts Common to All Systems: Conveyance

Operation of the conveyance pipelines is expected to result in minimal additional light and glare because the conveyance pipelines would be underground. However, any above-ground facilities at portal sites for dechlorination, tunnel access, odor control, and/or ventilation would be equipped with outdoor security lighting. Illumination from these facilities is expected to have minimal impact on neighboring properties because the lights would be of minimal wattage (see below for a discussion of mitigation measures). To minimize impact, design of lighting at conveyance facilities would follow the IESNA and IDA standards and guidelines applicable to the area in which the specific facility was located.

Proposed Mitigation Common to All Systems: Conveyance

Proposed mitigation at the conveyance corridors would be the same as that identified for the treatment plant sites. For more detail, see Appendix 13-B, Light and Glare: Conveyance.

13.3.2.3 Outfall Impacts Common to All Systems

Construction Impacts Common to All Systems: Outfall

Impacts during construction of the marine outfall, particularly on-land segments but also offshore, would be similar to those described above for the treatment plant and conveyance portals. It is anticipated that outfall construction could occur during periods of darkness and during evening hours, requiring construction lighting of the site. This would result in temporary light and glare impacts to surrounding land uses. The land uses near the Route 9 outfall site (the Chevron Richmond Beach Asphalt Terminal) are residential and industrial (Point Wells). The land uses near the Unocal outfall site are residential, recreational (Marina Beach Park), and commercial (Port of Edmonds).

Construction activities would likely be limited to daylight hours in the case of open cut excavation. Offshore construction methods such as bottom pull and controlled submergence would include some activities that would proceed 24 hours per day. Segmental lay pipeline installation would be limited to daylight hours. Total outfall construction, both onshore and offshore, is expected to last from 10 to 12 months potentially split between two summers.

Impacts of outfall construction would be similar for both Zones 6 and 7S. However, construction at Zone 6 would be located nearer to residential and recreational areas and, therefore, expected to have a greater impact. King County will work with potentially affected parties to identify appropriate mitigation measures, and employ specific

mitigation measures as described in the mitigation section of this chapter to minimize the illumination impacts to those affected.

Operation Impacts Common to All Systems: Outfall

Operation of the outfall would not require lighting. The outfall pipeline would be installed below-ground and underwater and would not be visible by potential light and glare receptors.

Proposed Mitigation Common to All Systems: Outfall

Proposed mitigation for outfall construction would be the same as identified for the treatment plant sites and conveyance corridors. While security lighting may not be required on an offshore barge, lighting on the barge that is used if necessary for outfall construction would include downcast lighting fixtures and other measures to shield light sources as described in the mitigation section of this chapter. Navigation lighting as required by the U.S. Coast Guard would be included on the barge and would not be shielded. King County would work with contractors to provide barge lighting with cutoff optics and minimal exterior lighting in accordance with U.S. Coast Guard regulations. No mitigation would be required for outfall operation as there would be no lights.

13.3.3 Impacts and Mitigation: Route 9 System

13.3.3.1 Treatment Plant and Conveyance: Route 9

Construction Impacts: Route 9 Treatment Plant and Conveyance

Construction impacts would be as described above under Impacts and Mitigation Common to All Systems. Construction lighting levels would be designed so as not to exceed 1 lux along the property boundary except at entrances. This is based on lighting to the E2 classification of RP-33-99, which suggests that post-curfew lighting be limited to 1 lux or less.

Table 13-7 identifies the potential impacts at the primary portals. Similar information on the secondary portals is included in Appendix 13-B, Light and Glare: Conveyance.

Portal 41 Influent Pump Station Option

Light and glare impacts related to construction of the IPS at Portal 41 are similar to those identified for construction at Portal 41 in Table 13-7. However, because the overall construction area would be increased, there will be a larger area with the potential to generate light and glare impacts during the first 2 years of site development. Construction lighting during nighttime hours could create localized increases in lighting, visible to adjacent office buildings, residences, and roadways.

Table 13-7. Potential Impacts at Primary Candidate Portal Sites on the Route 9 Corridors

Candidate Portal Site	Adjacent Land Use	Potential Impacts
195th Street corridor		
Portal Siting Area 11		
A	Light industrial and commercial area with retail/business north of NE Bothell Way	Light from the site could potentially be seen from commercial buildings to the south, north, southeast, northeast, and by residences on the hill to the northwest; light from the site could potentially impact adjacent buildings; light from the site could potentially impact the traffic from NE 175th St., NE Bothell Way, and Juanita Dr. NE
B	Light industrial and commercial area with retail/business north of NE Bothell Way	Light from the site could potentially be seen from commercial buildings to the, southeast, northeast, and by residences on the hill to the northwest, light from the site could potentially intrude on adjacent buildings; traffic along NE 175th St. and Juanita Dr. NE could potentially be impacted by light
C	Urban commercial areas surround the site with residential area to northwest	Light from the site could be seen from surrounding buildings and roads (NE 181st St., 68th Ave. NE, residences on the hill to the west); light could potentially intrude on adjacent buildings
Portal Siting Area 44		
C	Rural and residential and forested, buildings adjacent northwest and southwest	Light from the site could potentially intrude on adjacent buildings; light from the site could impact the traffic along 80th Ave. NE
D	Rural and residential, forested, no apparent buildings immediately adjacent to property	Light from the site could be seen from 80th Ave. NE, NE 195th St., and NE 192nd St., and residences on NE 195th St.; light from the site could potentially intrude into residences and buildings adjacent to the site
E	Rural and residential to the south and west with open space to the north and forested to the east	Light from the site could potentially be seen by adjacent buildings/residences to the north, west, and south, and NE 195th St.
Portal Siting Area 41		
A	Urban commercial (office park)	Light from the site could potentially be seen from North Creek Parkway, NE 195th St. and adjacent office buildings to west and south
C	Urban commercial (office park) to the north, south, and west, residential to the east, ball field to the southwest	Light from the site could potentially be seen from NE 195th St., NE Hollyhills Dr., and adjacent office buildings
D	Urban commercial (office park), sportsfield to the west, grassy park area to the northeast	Light from the site could potentially be seen from 120th Ave. NE and from adjacent office buildings

Table 13-7. Potential Impacts at Primary Candidate Portal Sites on the Route 9 Corridors (cont.)

Candidate Portal Site	Adjacent Land Use	Potential Impacts
X	Light industrial	Light from the site could potentially be seen from office buildings to the south and north
W	Residential with some open space	Light from the site could potentially be seen from Beardslee Blvd., NE 195th St., I-405 and residences on Ross Rd.
J	Commercial office-park vacant site to the north	Light from the site could potentially be seen from NE 195th Street, North Creek Parkway and adjacent office buildings to the south
Portal Siting Area 5		
B	Commercial to the northwest, southeast, and northeast along Ballinger Way NE, residential along the southern half of site	Light from the site could be seen from adjacent commercial buildings along Ballinger Way NE, from Ballinger Way NE, and from residences adjacent the south half of the site; light from the site could potentially intrude on adjacent buildings
G	Commercial to the northwest, southeast, and northeast along Ballinger Way NE	Light from the site could potentially be seen from adjacent commercial buildings along Ballinger Way NE, from Ballinger Way NE
X	Commercial and Ballinger Way NE	Light from the site could potentially be seen from surrounding commercial buildings along Ballinger Way NE, and from Ballinger Way NE, 15th Ave. NE and the intersection of 244th St. SW and Ballinger Way NE
Portal Siting Area 19		
C	Industrial Chevron terminal to the northwest, residential to the east, south and southeast, Puget Sound to the west, wooded area to the northeast	Light from the site could potentially be seen by adjacent industrial facilities to the north and from residences and roads adjacent to and overlooking the site and Puget Sound
228th Street corridor		
Portal Siting Area 11		
Same as 195th Alignment		
Portal Siting Area 44		
Same as 195th Alignment		
Portal Siting Area 41		
Same as 195th Alignment		

Table 13-7. Potential Impacts at Primary Candidate Portal Sites on the Route 9 Corridors (cont.)

Candidate Portal Site	Adjacent Land Use	Potential Impacts
Portal Siting Area 39		
B	Rural and residential west, south, and east, office buildings across 228th St SE to the north; light industrial	Light from the site could be seen from the office buildings to the north residences to the east, 228th St. SE, 29th Dr. SE, light from the site could potentially intrude on adjacent buildings
C	Rural and residential surrounding the site, there are buildings adjacent to the site on the west side and open space to the southwest	Light from the site could impact traffic along 228th St. SE; light from the site could be seen from residences to the east, west, and north; light could potentially intrude on adjacent buildings
D	Rural and residential with an adjacent building north, additional open space to the south	Light from the site could be seen from residences in all directions, 31st Ave. SE, and residences or buildings above/below on the hill; light from the site could potentially intrude on adjacent residences and buildings
Portal Siting Area 33		
A	Rural and residential area with some trees to the north and east	Light from the site could be seen from residences to the south and west and from residential roads
C	Rural and residential with some trees	Light from the site could be seen from adjacent roads (Locust Way, 228th St. SW), and residences on the hill to the west and nearby to the north, east and south
D	Rural and residential with some trees	Light from the site could be seen from residences nearby to the east and south, Locust Way, and 228th St. SW
Portal Siting Area 26		
A	Residential with open space to the south	Light from the site could be seen from residences and buildings to east, north, west, and southwest; light from the site could potentially trespass into adjacent residences, traffic on Lakeview Dr. could potentially be impacted from the glare of the light from the site
C	Commercial to the north, south, and west along SR-99, residential to the east	Light from the site could be seen from residences to south and east, commercial to north and west, SR-99, and 224th St. SW, light from the site could potentially intrude into adjacent buildings and residences
D	Residential to the north, west, and south, ball field is to the southwest and trees to the east	Light from the site could potentially be seen from residences and buildings from the east, north, west, and southwest, 228th St. SW, and 74th Ave. W

Operation Impacts: Route 9 Treatment Plant and Conveyance

The Route 9 site would not likely be directly visible from neighboring residential areas, thus reducing impacts from light and glare. Illumination modeling was performed for the Final EIS. The modeling used a horizontal grid with receptors placed at 10-foot intervals. Grids were located along the project boundary extending at least 20 feet on either side of the boundary. A grid was also established for the site with a 10-foot receptor grid. The grids were located at the ground elevation. One model was developed for a 54-mgd plant. The potential light and glare impacts for the 36-mgd plant would be less than the 54-mgd modeling results due to the smaller facility size.

The results of the modeling are presented in lux. Table 13-1 lists typical lux values. A typical city street, for example, has a lux value of 15. As shown in Table 13-6, the allowable lux values in the area surrounding the project site for Zone E2, which is the Route 9 zone, are 3 lux pre-curfew and 1 lux post-curfew. The current post-curfew lux values in the areas surrounding the Route 9 site, as shown in Table 13-2, are 0 to 4 lux.

For the Route 9 54-mgd plant, the average onsite pre-curfew modeled lux values on the site were 0 to 1.6 lux. The perimeter levels are all less than 1 lux, the E2 requirement as shown in Table 13-6, except for at the plant entrances, where the lux levels are up to 5. This value is above the 3 lux pre-curfew value. The value should be not a significant impact since this only occurs at the intersections with the plant entrances where safety is of greater concern. The existing lux levels are 0 to 4 lux, as shown in Table 13-2. Details on the modeling are included in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants. Refer to Chapter 12 for a description of views of the site. Berming and planting along the Route 9 site would hide much of the structures and lighting sources from view of motorists on SR-9 and from neighbors on the west side of SR-9.

Operation impacts for the Route 9 conveyance corridors are as described under Operation Impacts Common to All Systems: Conveyance

Portal 41 Influent Pump Station Option

Lighting impacts after construction are expected to be minimal, most likely less than would be created for a business use on the site. Security lighting would be required during nighttime hours but would utilize low-level lighting to minimize spillover and would be similar to existing office buildings in the area. Light from operation of the pump station could potentially be visible to adjacent office buildings, residences and roadways depending on the site chosen. Glass will be incorporated sparingly into facility design, resulting in minimal glare. The final pump station site would be selected with the intention of minimizing impacts to surrounding neighborhoods.

Relocation of the IPS to Portal Siting Area 41 would provide corresponding reductions in construction-related and operational nighttime light impacts at the treatment plant site.

Proposed Mitigation: Route 9 Treatment Plant and Conveyance

Proposed mitigation would be the same as that identified for the treatment plant sites and conveyance corridors for both systems.

13.3.3.2 Outfall: Route 9

Construction impacts, operation impacts, and proposed mitigation for the Route 9 outfall would be as described earlier under Impacts Common to All Systems. No mitigation measures are needed for outfall operations.

13.3.4 Impacts and Mitigation: Unocal System

13.3.4.1 Treatment Plant and Conveyance: Unocal

Construction Impacts: Unocal Treatment Plant and Conveyance

Construction impacts would be as described above under Impacts and Mitigation Common to All Systems. Lighting levels would be designed so as not to exceed 2 lux at the property line closest to adjacent residences on the southern boundary of the site. This is based on lighting to the E3 classification of RP-33-99, which suggests that the post-curfew lighting be limited to 2 lux or less. Because the Unocal site is more sloping than the Route 9 site, additional attention will be needed for light placement at the site, to contain lighting within the site as much as possible.

Table 13-8 identifies the potential impacts at the primary portals for the Unocal system. Similar information on the secondary portals is included in Appendix 13-B, Light and Glare: Conveyance.

Operation Impacts: Unocal Treatment Plant and Conveyance

The Unocal site is located on a hillside that is visible from the surrounding neighbors to the north and east. Operation impacts include light and glare from routine operations that could be observed by neighbors that view the site. Illumination modeling was performed for the Final EIS. The modeling used a horizontal perimeter grid (along the northeast, northwest, and south site property lines) with receptors placed at 10-foot intervals in a 20-foot width (10 feet inside the property line and 10 feet outside). Three horizontal facility grids were prepared: one at elevation 20 feet (lower terrace), one at elevation 35 feet (plant entrance), and one at elevation 125 (upper terrace). The facility grids had receptors placed at 10-foot intervals. The lid was also modeled at elevation 50.

Table 13-8. Potential Impacts at Primary Candidate Portal Sites on the Unocal Corridor

Candidate Portal Site	Adjacent land use	Potential Impacts
Portal Siting Area 3		
D	Single-family residential	Residences to east and west and motorists along Edmonds Way could potentially be affected by lighting used during construction
E	Single-family residential with commercial to the north	Light could be seen from residences uphill to the north, south, and east, Edmonds Way, and local residential roads; light from the site could potentially intrude on adjacent buildings
F	Single-family residential with trees to the north, east and west, rural residential to the south	Light from the site could be seen from residences to the south and Edmonds Way, and local residential roads, light from the site could potentially intrude on adjacent buildings, glare may be a problem for vehicles driving at night, the adjacent roads have minimal lighting and the site is higher than the road
Portal Siting Area 7		
A	Residential with some trees to the north, east, and south, school to the north, King County utility to the west	Residences from the north, south, and west could potentially see light from the site; light from the site could impact traffic on 25th Ave. NE
B	Residential to the southwest, school to the northeast, ball field to the east, bog and park to the north	Residences from the north, south, and west could potentially see light from the site; light from the site could potentially impact traffic along Ballinger Rd. NE and 25th Ave. NE
C	Residential with some trees to the north, school to the northeast, ball field to the east, King County utility to the south	Residences from the north, south, and west could potentially see light from the site; light from the site could potentially impact traffic along Ballinger Rd. NE and 25th Ave. NE
Portal Siting Area 11		
A	Light industrial and commercial area, commercial area has retail/business north of NE Bothell Way	Light from the site could potentially be seen from commercial buildings to the south, north, southeast, northeast, and by residences on the hill to the northwest; light from the site could potentially intrude on adjacent buildings; light from the site could potentially impact the traffic from NE 175th St., NE Bothell Way, and Juanita Dr. NE

Table 13-8. Potential Impacts at Primary Candidate Portal Sites on the Unocal Corridor (cont.)

Candidate Site	Adjacent land use	Potential Impacts
B	Light industrial and commercial area, commercial area has retail/business north of NE Bothell Way	Light from the site could potentially be seen from commercial buildings to the, southeast, northeast, and by residences on the hill to the northwest, light from the site could potentially intrude on adjacent buildings; traffic along NE 175th St. and Juanita Dr. NE could potentially be impacted by light
C	Urban commercial area surrounds site with residential area to northwest	Light from the site could be seen from surrounding buildings and roads (NE 181st St., 68th Ave. NE, residences on the hill to the west); light could potentially intrude on adjacent buildings
Portal Siting Area 14		
A	Urban commercial (office park); ballfield to the north	Light from the site could be seen from Office buildings to east and west, North Creek Pkwy. S, light from the site could potentially intrude on adjacent buildings
B	Urban commercial (office park); ballfield to the north	Light from the site could be seen from Office buildings to east, north, and west, North Creek Pkwy. S, light from the site could potentially intrude on adjacent buildings
D	Urban commercial (office park)	Light from the site could potentially be seen from Office Park to the west and south, residences on the hill to the east, 120th Ave. NE, and North Creek Pkwy. S

Parking, roadways, ferry entrance, and exit were modeled at a 10-foot receptor spacing in addition to the treatment plant facility grids. Two models were developed: 72 mgd and 72 mgd with lid. The potential light and glare impacts for the 36- and 54-mgd plants would be less than the 72-mgd modeling results due to the smaller facility size. These models represent the worst case for potential offsite light impacts.

The results of the modeling are presented in lux. Table 13-1 lists typical lux values. A typical city street, for example, has a lux value of 15. As shown in Table 13-6, the allowable lux values in the area surrounding the project site for Zone E3, which is the Unocal zone, are 8 lux pre-curfew and 2 lux post-curfew. The current post-curfew lux values in the areas surrounding the Unocal site, as shown in Table 13-3, are 0 to 4 lux. The average on-site pre-curfew modeled lux value is 1.84 lux, and the perimeter values were all less than 1 lux, except for the plant entrances where the lux levels range from 2 to 5 lux. Details on the modeling are included in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants.

Operation impacts for the Unocal conveyance system corridor are as described under Operation Impacts Common to All Systems: Conveyance.

Unocal 72-mgd Sub-Alternative

Impacts from the 72-mgd plant would be greater than the 54-mgd plant due to the increased number of process units and space used. This would require an approximate increase in quantity of exterior luminaires of 10 percent. However, the additional light and glare would be only marginally greater since the overall project site would not change, and the additional lights would utilize the same mitigation measures as the other lights.

For the Unocal 72-mgd plant, the average onsite pre-curfew modeled lux values along the perimeter were 0 to 1 lux for the horizontal receptors. These lux levels are below the E3 requirements and lower than the existing values of 0 to 4 lux. Details on the modeling are included in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants. Refer to Chapter 12 for a description of views of the site.

Unocal Structural Lid Sub-Alternative

Impacts of a multi-modal lidded facility would depend in large part upon the operating characteristics of the multimodal facility, which could generate significant levels of light, especially due to the exposed nature of such a facility. In general, light levels from this sub-alternative could be 2 to 10 times greater than those from the 72-mgd non-lidded facility. This is due to the higher elevation of the lighting on the lid than the lighting on the covered portion of the treatment plant.

For the Unocal 72-mgd plant with the lid, the average onsite post-curfew modeled values along the perimeter were 0 to 4 lux for both the horizontal and vertical receptors. The levels are all less than 2 lux, the E3 requirement, except along the northwest property line, where the average values are up to 4 lux. The high values (4 lux) are from the

parking lot lighting on the lid. Details on the modeling are included in Appendix 13-A, Illumination Modeling of Route 9 and Unocal Treatment Plants. Refer to Chapter 12 for a description of views of the site.

Proposed Mitigation: Unocal Treatment Plant and Conveyance

Proposed mitigation measures would be the same as those identified for the treatment plant sites and conveyance corridors for both systems. No mitigation measures are needed for outfall operations.

Mitigation for construction-related light impacts would be the same as described for Proposed Mitigation Common to All Systems: Treatment Plant.

13.3.4.2 Outfall: Unocal

Construction impacts, operation impacts, and proposed mitigation for the Unocal outfall would be as described earlier under Outfall Impacts Common to All Systems.

13.3.5 No Action Alternative

Levels of light and glare would remain unchanged as a result of implementation of the No Action Alternative. There would be no construction activities and existing levels of light and glare would remain in the area.

13.3.6 Cumulative Impacts

Increased development and urbanization throughout the area will likely result in increased light levels. Construction lighting at the treatment plant, portal and pump station locations, and the marine outfall would temporarily increase overall light levels in the vicinity of the construction sites; however, these impacts would largely diminish following the construction period. Long-term lighting of the treatment plant, pump stations, and any above-ground facilities for tunnel access or odor control, and/or ventilation is not expected to significantly increase light and glare at either site.

13.4 Significant Unavoidable Adverse Impacts

Construction lighting at treatment plant sites, portal locations, and outfall locations could create localized increases in lighting that would be considered significant by adjacent residences. Lighting increases during construction are unavoidable and would require all reasonably available mitigation measures. These include those items listed above for the treatment plants, but the increase could still be considered significant during the approximately 6-year construction period at the treatment plant site and up to 4-year construction period for portals and a pump station.

As noted above, increases in light levels at the plant sites due to project operation would be less than the values defined in IESNA's RP-33-99. All project site lighting levels would be designed not to exceed the IESNA recommended levels for the proposed activities. In addition, the IDA guidelines for outdoor lighting will be used. As a result, no significant unavoidable adverse impacts would occur during project operation.

13.5 Summary of Impacts and Mitigation

Table 13-9 provides a summary of potential light and glare impacts and mitigation measures for the Brightwater System alternatives.

Table 13-9. Summary of Potential Light and Glare Impacts and Proposed Mitigation for Brightwater Systems

Brightwater System	System Component	Impacts	Mitigation
Common to All Systems	Treatment Plant	<u>Construction</u> <ul style="list-style-type: none"> Construction activities for the plant have potential to generate temporary light and glare issues. 	<u>Construction</u> <ul style="list-style-type: none"> Construction management practices include turning off all but essential lights after construction, aiming the lights toward the site, and following IESNA and IDA guidelines.
		<u>Operation</u> <ul style="list-style-type: none"> By carefully placing the lights and following the mitigation measures listed in this chapter, measurable light spillage at the property line should not exceed levels recommended under IESNA guidelines. 	<u>Operation</u> <ul style="list-style-type: none"> No further mitigation is required.
	Conveyance	<u>Construction</u> <ul style="list-style-type: none"> Construction activities for conveyance have potential to generate temporary light and glare issues at portal construction sites. 	<u>Construction</u> <ul style="list-style-type: none"> Construction management practices include turning off all but essential lights, aiming the lights toward the site, and following IESNA and IDA guidelines.
		<u>Operation</u> <ul style="list-style-type: none"> The facilities along the conveyance line would require minimal lighting. By carefully placing the lights and following the mitigation measures listed in this chapter, measurable light spillage at the portal sites' property line should not exceed levels recommended under IESNA guidelines. 	<u>Operation</u> <ul style="list-style-type: none"> No further mitigation is required.
	Outfall Zones	<u>Construction</u> <ul style="list-style-type: none"> Construction activities for outfall have potential to generate temporary light and glare issues. 	<u>Construction</u> <ul style="list-style-type: none"> Construction management practices include turning off all but essential lights after construction, aiming the lights toward the site, and following IESNA and IDA guidelines.
		<u>Operation</u> <ul style="list-style-type: none"> No light and glare impacts would result from outfall operation, as no lighting would be used at the outfall. 	<u>Operation</u> <ul style="list-style-type: none"> No mitigation is required.

**Table 13-9. Summary of Potential Light and Glare Impacts and Proposed Mitigation for
Brightwater Systems (cont.)**

Brightwater System	System Component	Impacts	Mitigation
Route 9–195th Street System	Treatment Plant	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described above under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Mitigation would be as described above under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Impacts would be as described above under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Mitigation would be as described above under Common to All Systems.
	Conveyance	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Mitigation would be as described above under Common to All Systems.
	Outfall	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described above under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Mitigation would be as described above under Common to All Systems.

Table 13-9. Summary of Potential Light and Glare Impacts and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Mitigation
Route 9–228th Street System	Treatment Plant	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
	Conveyance	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
	Outfall	<u>Construction</u> <ul style="list-style-type: none"> Impacts would be as described under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Similar to impacts discussed under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
Unocal System	Treatment Plant	<u>Construction</u> <ul style="list-style-type: none"> Similar to Route 9; however, more attention to placement of the lights will be required due to the sloping nature of the site. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Similar to impacts discussed under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.

Table 13-9. Summary of Potential Light and Glare Impacts and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Mitigation
Unocal System (cont.)	Conveyance	<u>Construction</u> <ul style="list-style-type: none"> Similar to impacts discussed under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Similar to those discussed under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
	Outfall	<u>Construction</u> <ul style="list-style-type: none"> Same as discussed under Common to All Systems. 	<u>Construction</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
		<u>Operation</u> <ul style="list-style-type: none"> Same as discussed under Common to All Systems. 	<u>Operation</u> <ul style="list-style-type: none"> Same mitigation as discussed under Common to All Systems.
No Action Alternative	Treatment Plant	<u>Construction</u> <ul style="list-style-type: none"> No wastewater treatment plant construction would take place, and no light and glare impacts would occur. 	<u>Construction</u> <ul style="list-style-type: none"> No mitigation would be required.
		<u>Operation</u> <ul style="list-style-type: none"> No light and glare impacts would occur from construction of Brightwater, however, there would be new lighting from commercial and residential development at the Unocal Site, and from new development at the Route 9 site. 	<u>Operation</u> <ul style="list-style-type: none"> No mitigation would be required.
	Conveyance	<u>Construction</u> <ul style="list-style-type: none"> No light and glare impacts would occur. 	<u>Construction</u> <ul style="list-style-type: none"> No mitigation would be required.
		<u>Operation</u> <ul style="list-style-type: none"> No light and glare impacts would occur. 	<u>Operation</u> <ul style="list-style-type: none"> No mitigation would be required.
	Outfall	<u>Construction</u> <ul style="list-style-type: none"> No light and glare impacts would occur. 	<u>Construction</u> <ul style="list-style-type: none"> No mitigation would be required.
		<u>Operation</u> <ul style="list-style-type: none"> No light and glare impacts would occur. 	<u>Operation</u> <ul style="list-style-type: none"> No mitigation would be required.

13.6 References

- IDA (International Dark-Sky Association). 2002. *Outdoor lighting code handbook*. Version 1.14. Tucson, AZ. September 2002. Available at <http://www.darksky.org>
- IESNA (Illuminating Engineering Society of North America). 1999. *Lighting for exterior environments. Recommended practice RP-33-99*. New York: IESNA Outdoor Environmental Lighting Committee.
- IESNA (Illuminating Engineering Society of North America). 2000. *IESNA Lighting Handbook* (9th ed.) Ed. by M.S. Rea. New York.

The figures for this chapter are provided as separate files on this web site.

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LIST OF FIGURES

- | | |
|-------------|---|
| Figure 13-1 | Light Observation Points - Unocal Site |
| Figure 13-2 | Light Observation Points - Route 9 Site |